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Vol. 18 — No. 8

CONTENTS

ORIGINAL PAPERS

Evaluation of Drivers Tests. Earl Allgaier 345
An Investigation of Interpupillary Measurements. S. Herman Shurin 348
Vertigo and Its Relation to Ear Conditions. Martin A. Furman 357
Aniseikonia. Harold M. Fisher 362
Astigmatism. Louis Jaques 370

EDITORIALS

Comments on the Betts Stereoscopic Visual Acuity Charts. Carel C. Koch . . 376

SPECIAL REPORTS

Controlled Research Versus Clinical Findings. George A. Parkins 378

TRANSACTIONS OF THE ACADEMY by J. Fred Andreae 386

ABSTRACTS 387-392

The Birth o

an Industry

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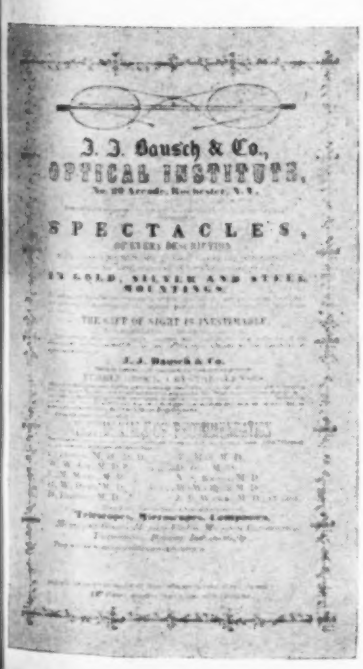
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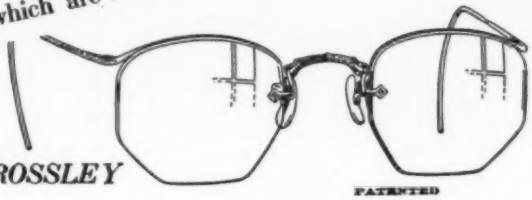

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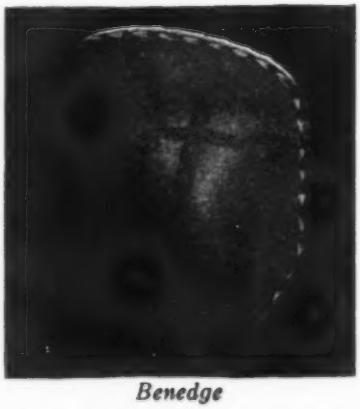

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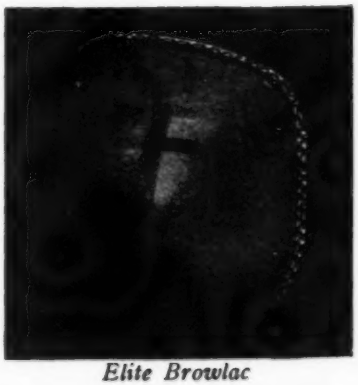

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Vol. 18 AUGUST, 1941 No. 8

EVALUATION OF DRIVER TESTS*

Earl Allgaier
Washington, D. C.

It is quite obvious that the complicated ability to drive an automobile cannot be measured by any simple test. However, it is quite important that we know which of the various tests used are the best indicators of driving ability.

Before any individual test can be evaluated there must be established some criterion of driving ability. The data to be here presented are unique in that the criterion of driving ability used is much superior to that usually available. The past record of a man's driving too frequently reflects more or less temporary conditions which may have ceased to exist at the time of the testing. In the present instance the persons involved were given a very thorough road test under expert supervision in addition to various skill and psychophysical tests.

In August, 1940, the Ford Good Drivers League selected by means of preliminary tests, from 50,000 boys of high school age, a boy to represent each state. Awarding of scholarships ranging up to $5,000 was based on a competitive examination covering a period of two days on the grounds of the New York World's Fair. Practically all of the tests used were developed and personally supervised by specialists in the examination and testing of drivers from the American Automobile Association and Iowa State College.

The four types of tests used are briefly described in the following table with the weighting given each type in determining the final score.

*Submitted on April 10, 1941 for publication in the August, 1941 issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

TABLE I

Test	Weighting
Daytime driving. This was over a route 6.8 miles long through New York traffic. A very extensive check list was used for checking the driver at all points along the route.	47%
Nighttime driving. This was similar to the above but given at night over a route 2.6 miles long.	19%
Skill or maneuver tests. The drivers were required to perform special maneuvers such as parallel parking, weaving between stanchions, driving in a straight line, etc.	23%
Psychophysical tests. These included various vision, reaction time, strength and similar tests.	11%
Total	100%

It seems quite reasonable to assume that the final total scores obtained from the above weighting were a valid criterion of driving ability at the time the tests were given. In analyzing a number of individual skill and psychophysical tests included in the last two sections of the above table, the 48 contestants were divided into 4 groups of 12 boys each. Group A included the 12 boys making the highest final total scores while group D included the 12 making the lowest final total scores.

Assuming the total final score to be the best criterion of driving ability 14 individual tests have been analyzed and rated as to their value in differentiating between the highest ranking drivers (group A) and the lowest ranking drivers (group D). All scores are expressed in standard deviation units so that direct comparisons are possible among the various tests. In table II the 14 individual tests analyzed are listed in order of their merit.

TABLE II

Class of Test	Test	Difference in Average Scores Made By Best (Group A) and Poorest Drivers (Group D)
Driving Skill	Parallel Parking in 20′ space	1.18

Psychophysical	Distance Judgment measured by lining up miniature cars side by side	0.87
Psychophysical	Resistance to Glare	0.86
Psychophysical	Hand Steadiness	0.86
Driving Skill	Stopping car with tires on a frame of 2x4's	0.80
Driving Skill	Stopping car in shortest possible distance from a speed of 20 m.p.h.	0.75
Driving Skill	Weaving between stanchions placed at 25 foot intervals	0.71
Psychophysical	Complex reaction time—reaction to 3 signals presented in random order	0.63
Driving Skill	Stopping a car smoothly in 40 feet from a speed of 20 m.p.h.	0.60
Psychophysical	Field of Vision—ability to see to the sides	0.41
Psychophysical	Speed of hand movement	0.34
Psychophysical	Strength of grip	0.25
Driving Skill	Backing along a curb for 200 feet	0.11
Driving Skill	Parking in a temporary garage	0.05

It will be noted that parallel parking was the most differentiating test, showing twice as great a difference between groups A and D as stopping a car smoothly on a frame of 2x4's. Distance judgment and resistance to glare also ranked near the top of the list.

It is interesting to note that in spite of the fact that the psychophysical tests contributed only 11% to the final total score, of the 13 persons ranking highest on the psychophysical tests 8 fell in group A, 4 in group B and 1 in group C.

The above data are presented in an attempt to evaluate various tests in regard to their effectiveness in differentiating between drivers differing in ability. Additional data of this type are needed to substantiate or modify the above conclusions so that tests for the licensing and selection of drivers can be chosen on the basis of their actual worth, rather than their apparent merit.

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WASHINGTON, D. C.

AN INVESTIGATION OF INTERPUPILLARY MEASUREMENTS*

S. Herman Shurin, O.D., F.A.A.O.
Kansas City, Mo.

Ordinarily, in considering the measurement of the interpupillary distance by the use of either the metric ruler or some form of pupillometer, we assume that we are actually concerned with the distance between the pupils; this assumption is not wholly correct inasmuch as we are primarily interested in the visual axes and the centers of rotation of the two eyes; all this holds true whether we measure from pupil to pupil or from the center of the nose to the center of each pupil.

The visual axes might be converged if the fixation objects are closer together than the patient's interpupillary distance; they might be diverged if the separation between the fixation objects is greater than the patient's interpupillary distance; they probably would be parallel if the distances were the same; if, in this last case, the observer's interpupillary distance is the same as the patient's, and also the fixation separation coincided with the two, then of course we would be correct in assuming that this distance, measured on the scale, would be correct, and the situation would be ideal as far as measurements were concerned. However, we do have a small, but calculable error, when the patient's and the observer's interpupillary distances do not coincide, and this is more easily done accurately when the distances are measured upon some form of instrument that also takes into account the observer's distance from the center of the nose to the center of the pupils. Our problem is aggravated by the fact that we do not take a reading directly on the plane of the pupils but at some distance away, where the scale rests on the nose; also in using pupillometers, the fixation objects are on a different plane than the centers of rotation of the eyes of the observer.

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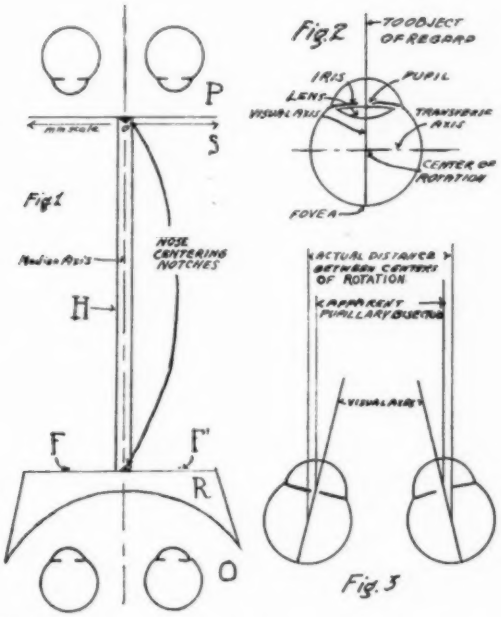
*An abridgment of the material presented before the American Academy of Optometry. For publication in the August, 1941 issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.



We shall presume that we have an apparatus for determining the patient's interpupillary distance. The essential parts of this instrument consist of (Fig. 1) S, a scale marked off in millimeters with its 0 point coinciding with the center of the crest of the nose; this scale shall be placed arbitrarily at the presumed plane of the lenses, 15 mm. from the cornea. H is a metal holder, which serves two purposes: (1) It serves to furnish a support for the operator by which he is enabled to maintain the apparatus in position while the reading is taken; (2) It serves to maintain a fixed relationship between the scale and the other accoutrements pertaining to the function of this apparatus. At the opposite end of H from S are fastened two fittings: F and F', a pair of fixation devices or marks, paired evenly about the axis of H (which is also in line with the 0 mark on the scale S); R is a hood, which serves to remove the extraneous light, and also aids in maintaining a fixed relationship between the distance S and the plane of the cornea of the observer. The two remaining essentials are the observer, O, and the subject or patient, P. The axis of H is also in line with the center of R which is also notched for the center of the nose of the observer.

Momentarily we shall review the physiologic optics of the eye. In Fig. 2 we have a schematic representation of the eye. It will be seen that the pupil coincides with the anterior surface of the lens. The lens surface is 3.6 mm. behind the anterior surface of the cornea (Zoethout). Zoethout further states that according to Helmholtz, the distinction be-

tween the line from the object of regard to the center of rotation and that drawn from the object of regard to the fovea, along the visual axis, is negligible. (Zoethout, Phys. Optics, ed. 1927, p. 254.) The center of rotation is located on the optic axis where the transverse axis crosses. Then we are primarily concerned with the axis which extends from the macula, through the center of rotation, through the center of the pupil, to the object of regard in the primary position, and not the center of the pupil per se. In Fig. 3 it can be seen that if the eyes are converged, and from an outside source, lines are drawn parallel to each other that bisect the pupils, then these bisectors do not coincide with the centers of rotation. It is these two centers of rotation in which we are primarily interested.

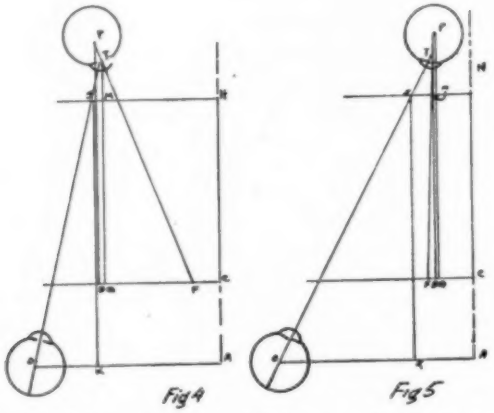


Fig 4 Fig 5

We have four things with which we shall deal. These are: The distance from the center of the nose of the observer to the center of rotation of each eye; the distance from the center of the nose of the patient to the center of rotation; the scale reading; and the distance from the center of the instrument (median axis) to the fixation points. The order of their arrangement could be determined from the permutation of 1.2. 3.4 which gives twenty-four different arrangements between these four elements when they are all different. Of these twenty-four different arrangements only eight enter into the problem as the other arrangements are impossible. We also have nine arrangements wherein two or more of these distances are identical. We have propounded one equation which will hold good in all of the seventeen different arrangements.

In Fig. 4 we assume a condition in which the observer's interpupillary distance is greater than the patient's, which in turn is greater than the separation of the fixation objects from the median axis. Our reading of the "p.d." as we can see, is ordinarily taken at S, at which

point the observer's visual axis crosses the scale and bisects the pupil. Suppose that at this point we drop a perpendicular SK. Now AO is the distance from the median line to the center of rotation of the observer's eye. SH is the distance from the median line to the scale reading. AO-AK = OK which is the difference between the scale reading and the observer's "p.d." (since AK is equal to HS by construction). We now have angles SKO and TMS as right angles, TM being drawn perpendicular to SH from the center of the patient's pupil. In this set up SM:OK::TM:SK. SK may be considered a fixed distance inasmuch as from H to C is known because they are both parts of the instrument and the distance from the fixation object at F can be figured to the center of rotation of the observer's eye; this can be figured by devising the instrument so that a given distance shall interpose between the plane of the fixation object and the plane of the observer's cornea and adding 13.5 mm. more to that distance to account for the distance between the anterior surface of the cornea and the center of rotation (O) of the observer's eye. Similarly the scale is set on the plane where the correcting lenses will be placed, i.e., 15 mm. in front of the anterior surface of the patient's cornea, and the center of the pupil is 3.5 mm. posterior to that, and the center of rotation (P) of the patient is 10 mm. posterior to that point. The patient's visual axis is being directed towards F. It is now easy to solve for SM by this means: SM = (TM/SK) OK. We now know the allowance to be made from the measured distance on the scale reading to the center of the pupil MH, but we have to solve for the distance between the center of the pupil and the center of rotation. We have coninued TM to Q where it crosses FC continued. From point P we now drop a perpendicular also to FC continued. We now have two similar triangles PBF and TQF. Since the distances are so small we shall consider PB equal to PT + TQ. We now have (BQ + QF) /QF = (PT + TQ) /TQ.

$$BQ+QF=\left(\frac{PT+TQ}{TQ}\right)QF$$

$$BQ=\left[\left(\frac{PT+TQ}{TQ}\right)QF\right]-QF$$

$$BQ=\left\{\left(\frac{PT+TQ}{TQ}\right)\left[SH-\left(\frac{TM}{SK}\right)OK\right]-FC\right\}-\left\{\left[SH-\left(\frac{TM}{SK}\right)OK\right]-FC\right\}$$

$$BQ=\left\{\left(\frac{PT+TQ}{TQ}\right)\left[SH-\left(\frac{TM}{SK}\right)\left[OA-SH\right]\right]-FC\right\}-\left\{\left[SH-\left(\frac{TM}{SK}\right)\left[OA-SH\right]\right]-FC\right\}$$

BQ will then be added to MH for final adjustment for correction of the differences in the p.d. of the observer and patient and the separation of the fixation object from the median axis.

In Fig. 5 the observer's interpupillary distance is greater than the fixation distance separation, which in turn is greater than the patient's interpupillary distance, and the scale reading is greater than the fixation distance; the equations can be solved in exactly the same manner as our first illustration (Fig. 4).

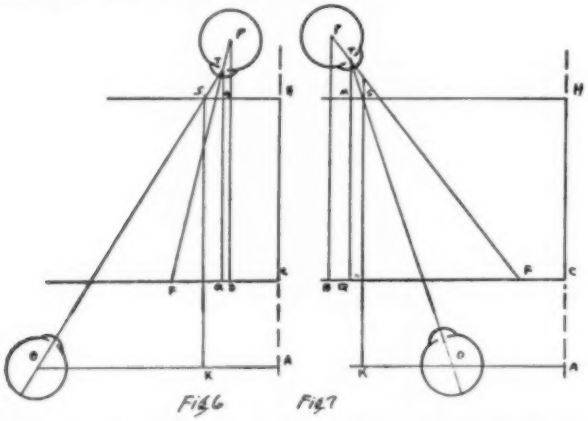


Fig 6 Fig 7

In Fig. 6 the observer's p.d. is greater than the fixation distance, which in turn is greater than the scale reading, and this in turn is also greater than the patient's "p.d." A similar equation will solve for the correction to be made.

In Fig. 7 the patient's p.d. is greater than the scale reading, which in turn is greater than the observer's p.d., which in turn is also greater than the fixation separation. A similar equation solves this problem too.

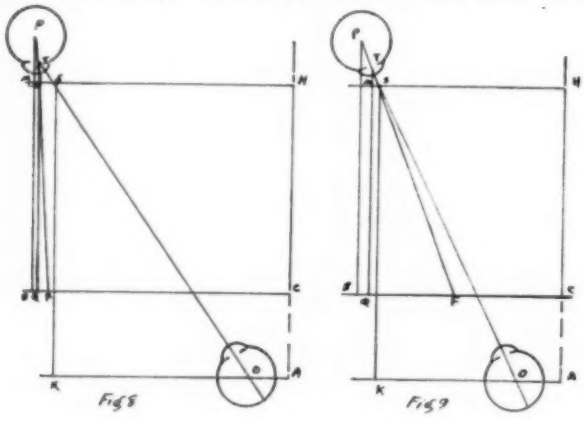


Fig 8 Fig 9

In Fig. 8 the patient's p.d. is greater than the fixation separation which is greater than the scale reading and the observer's p.d.

In Fig. 9 the patient's p.d. is greater than the scale reading which is greater than the fixation distance which is greater than the observer's p.d.

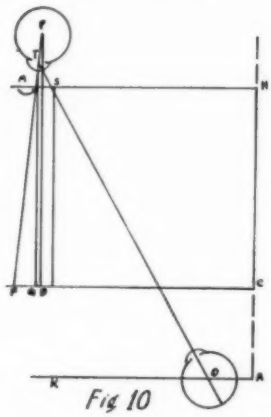


Fig 10

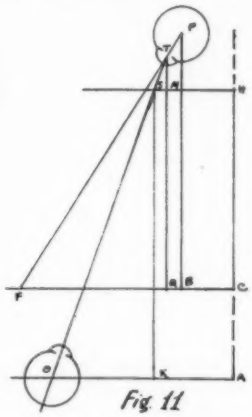


Fig 11

In Fig. 10 the fixation distance is greater than the patient's p.d. which is greater than the scale reading which is greater than the observer's p.d.

In Fig. 11 the fixation distance is greater than the observer's interpupillary distance, which is greater than the scale reading, which is greater than the patient's p.d. All of these problems can be solved with no modification in the equation.

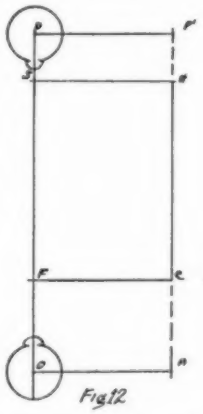


Fig 12

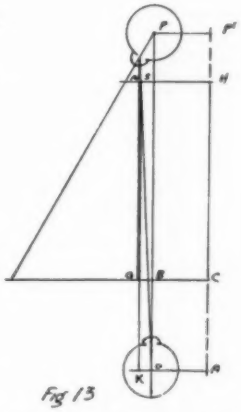


Fig 13

In Fig. 12 we assume a condition in which the distances are equal; then of course, SM = 0, and the correction BQ = 0, and our scale reading is the correct reading.

In Fig. 13 the observer's p.d. is equal to the patient's p.d., i.e., PP′ = OA, and the fixation distance is greater than either, therefore the scale reading will also be greater. The correction can be solved by the same equation.

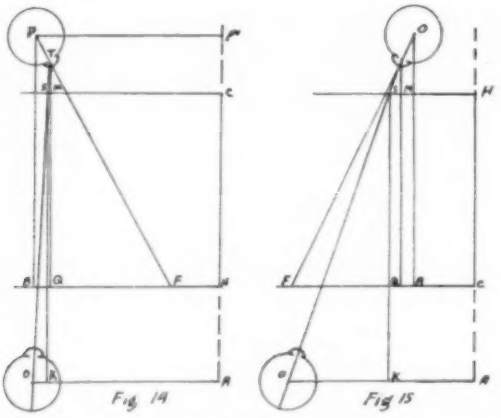


Fig. 14

Fig. 15

In Fig. 14, PP′ = OA, similarly the fixation distance is less than either and the scale reading is also less than either. Again correction can be made by solving through with the same formula.

In Fig. 15 we assume the observer's p.d. equal to the fixation distance (OA = FC), and the patient's p.d. less than either, with a resultant scale reading less than either. Again the correction can be solved by the same formula.

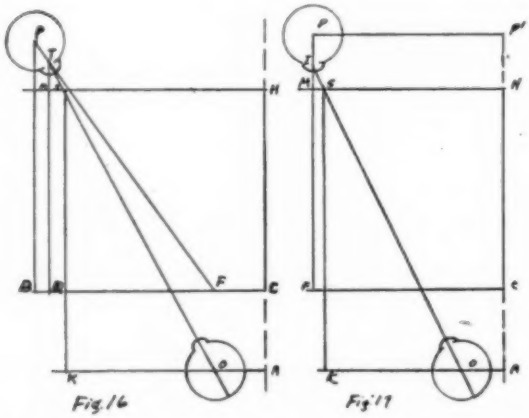


Fig. 16

Fig. 17

In Fig. 16 the fixation separation and observer's p.d. are equal (OA = FC) and are less than the patient's p.d., hence the scale reading is greater than either. It also can be solved by the same equation.

In Fig. 17 the patient's p.d. is equal to the fixation separation. PP′ = FC. Both are greater than the observer's p.d., hence the scale reading will be less than the patient's p.d. The same formula can be used to solve correction only for SM.

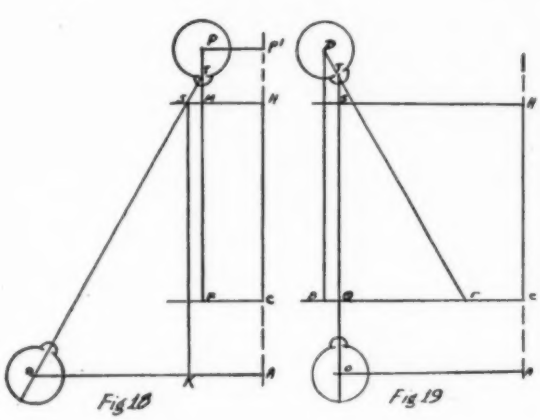


Fig 18

Fig 19

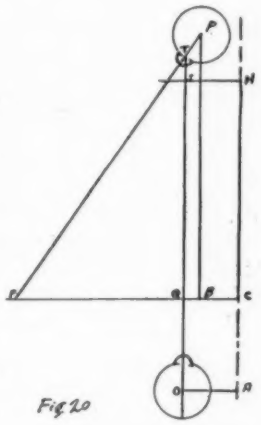


Fig 20

In Fig. 18 the patient's p.d. is also equal to the fixation distance; then PP′ = FC but they are less than the observer's p.d., therefore the scale reading is greater than the patient's p.d. and can be corrected by the use of the same formula correction only for SM.

In Fig. 19 the observer's p.d. is equal to the scale reading (OA = SH) but the fixation distance is less and the patient's p.d. is greater. Now SM becomes 0 and QF is OA-FC in other words

$$BQ = \frac{PT + TQ}{TQ} QF.$$

QF of course is equal to SH-FC.

In Fig. 20 the observer's p.d. is equal to the scale reading (OA = SH) but the patient's p.d. is less and the fixation distance is greater. Again SM becomes 0 and the formula becomes $BQ = \frac{PT + TQ}{TQ} QF.$

It will be quite evident that many times the eventual correction for the scale reading will become negligible or amount to 0. It would be interesting to attach a table of corrections accurate to within 0.12 mm. although for practical purposes accuracy to within 0.25 or 0.50 mm. would be of more value. Inasmuch as there is no instrument on the mar-

ket whereby an accurate bisection of the pupil is made under illumination for ease in seeing the pupil, with no modification by other lenses placed at a distance in front of the patient's cornea, and a fixed distance between the patient's cornea and scale, and fixation distance from the scale, with a fixed distance also from the fixation object to the observer's eye, there is no great need to evolve the complete set of tables for this particular purpose. That an instrument can be made that will answer all of these requirements is very possible; then it would be a simple matter to look up in the table the correction to be made knowing that the only variables are the observer's p.d. and the patient's p.d.

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VERTIGO IN ITS RELATION TO EAR CONDITIONS*

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INTRODUCTION

The symptom of vertigo is a suitable topic of interest to optometrists. Vertigo is encountered frequently by the optometrist and he should know when to recognize the symptom as arising from an ear condition.

The two most common ear conditions that cause vertigo are (1) Labyrinthitis and (2) Meniere's Disease. Our mutual interest in this presentation is not in labyrinthitis, for in this disease the patient has usually one sharp prolonged attack of vertigo secondary to an ear infection and is confined usually to bed. In Meniere's Disease, however, the vertigo is frequently very mild and transient and there are numerous attacks occurring over an extended period of time, viz., for days or years, such as one frequently encounters in ocular disturbances. I am therefore going to confine myself to a discussion of Meniere's Disease.

DEFINITION

Meniere's Disease should really not be called a *"disease"* since the underlying pathology is still very vague and uncertain. It is merely a group of symptoms, viz., a "syndrome," the two essential features of which are (1) *dizzy spells*, and (2) *deafness*. However, only rarely are the other symptoms absent, viz., *nausea* and *vomiting*, and *tinnitus*.

Pseudo-Meniere's Disease is Meniere's minus the deafness and tinnitus. This condition is by no means uncommon. The frequent change from Pseudo-Meniere's to Meniere's Disease with time means that in these cases the former is but an early stage of the latter.

Crowe considers that the presence of recurring vertigo alone, without deafness or tinnitus, is sufficient evidence on which to base the

*An abridgment of the material presented before the New York Academy of Optometry, March 18, 1941. Submitted for publication in the August, 1941 issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

diagnosis. It seems unnecessary to note any particular violence or frequency of the attacks before the diagnosis is made because every patient complaining of recurrent vertigo should be considered a potential victim of the disease.

SYMPTOMS IN A WELL ESTABLISHED CASE

(1) *Vertigo*: The vertigo is characterized by a sudden onset any time of day or night, even during sleep. The violence of an attack may vary from slight giddiness to an overpowering vertigo, accompanied by nausea, vomiting, sweat, pallor, diarrhea and collapse, lasting from minutes to days. If a patient is observed during the attack, a nystagmus is noted, either horizontal, rotary or undirectional, but owing to the short duration of most attacks, this symptom is rarely observed. The dizziness of Meniere's Disease is of a very definite character—objects rotate or jump rapidly. Patients who complain of general dizziness with a swooning sensation or an uncertain feeling in the head do not have Meniere's Disease. The attacks are recurrent and the patient is perfectly well between the paroxisms.

(2) *Deafness*: A constant impairment of hearing on one side is always present at some stage of the disease. Cases have been reported in which loss of hearing was not demonstrated until a number of attacks had occurred. It is not an infrequent experience to find that a unilateral deafness has been present for years, unknown to the patient; however, increased deafness is usually evident at the time of the attack. The deafness usually develops slowly but it may appear fairly abruptly. It is usually progressive up to a certain point, after which it is fairly stationary. At times, the hearing disappears suddenly and as suddenly returns, but this is unusual. In about ten per cent of the cases, the deafness is bilateral in the beginning or subsequently.

(3) *Tinnitus*: This is rarely absent. It is usually unilateral. If bilateral, it is more pronounced on the side of greater deafness. It may be intermittent or constant. The tinnitus varies in character—either a ringing, hissing or explosive noise. The beginning of tinnitus in the opposite ear is strong presumptive evidence that the disease is becoming bilateral. In the presence of bilateral deafness, an increase of the tinnitus on one side during a seizure is a definite aid in determining on which side the lesion is to be found.

(4) *Other Symptoms and Signs*: Various other symptoms are not infrequently present. *Diplopia* is noted during the attacks in about 25

per cent of the cases, no objective evidence of extra-ocular palsies can be observed during the time. *A tight feeling over the chest* has been noted a few times. *Headaches* are not uncommon. *Flashes of light*, dark spots and rings, may occur during or just after seizures.

PATHOLOGY AND ETIOLOGY

The pathology of Meniere's Disease is a moot question. The syndrome was established as a clinical entity by Meniere, a Frenchman, in 1861. He, however, knew nothing concerning the underlying pathology and in a search for the cause in a woman who died on the fifth day after the onset of the symptoms, he confused the pathology with that found in infectious labyrinthitis. He found, on autopsy, hemorrhagic pus in the semi-circular canals of the ear, and since this was in the days before Pasteur discovered bacteria as the cause of infection, the blood in the canals was given as the cause of the vertigo attack. This concept has so thoroughly permeated the literature that it is difficult to overcome even at the present time.

Today, the pathology of Meniere's Disease is still a moot question. It is attributed to many causes, as well as to many types of lesions. There is no doubt that the underlying pathology is something which effects the semi-circular canals of the ear, (the so-called labyrinth), or the nerve roots leading to and from the labyrinth. In the opinion of most medical internists and of many surgeons, the lesion is in the labyrinth itself. However, Dandy, the brain surgeon of Johns Hopkins University, is firmly convinced that the lesion is limited to the nerve root only and he says that "Meniere's Disease can be *permanently* cured by division of the auditory (or 8th) nerve." He says that "this procedure carries almost no risk to life," that "up to 1941, he has perfomed 401 operations for Meniere's with one death (due to meningitis)."

TREATMENT

The treatment depends on what is considered the underlying pathology. The pathology as expressed by many internists and surgeons is *some form of vasomotor disturbance, producing chemical and fluid changes in the labyrinth*, of temporary and at times permanent nature.

(1) *Histamine*: Horton, of the Mayo Clinic, has obtained marked success with the use of histamine, in the treatment of these cases; but the results are too recent to be given permanent and definite approval. He claims that in Meniere's, there is a local alteration in the permeability of the capillary wall, of the labyrinth, resulting in local edema. Histamine

is an important agent which affects capillary permeability. The resulting edema may well be comparable to the cotton-wool exudate in the retina and edema of the optic nerve head which are observed in hypertension. The degree and extent of involvement of the edema will determine the major symptoms which are present. The presence of tinnitus and varying degrees of deafness indicates that the process also involves the organ of hearing, viz., the cochlea. Horton has obtained some very interesting results with intravenous and subcutaneous doses of histamine. "Up to July 1, 1940, 49 cases were thus treated. Fifteen were known to be well to date, without further attacks. The others have had one or more recurrences of symptoms, but these symptoms have been eliminated each time by pushing the drug further." He concludes that his "work is still in progress" and that he feels that "the ultimate treatment will prove to be medical, not surgical."

(2) *Correction of Mineral Metabolism*: The theory that Meniere's Disease is due to an edematous change in the labyrinth, has brought forth another method of treatment. Foldes, Furstenberg, Mygind and Dederding, in their researches, have assumed that the increased edema and consequent pressure in the labyrinth, was due to faulty water and mineral metabolism, which allows water to collect and overload the fluid in the semicircular canals. The treatment is directed toward correcting this derangement in the water and mineral metabolism of the body, just as is done in those cases of water retention in nephrosis, e.g., a high-protein, low-carbohydrate and fat diet, since the last two, when given in normal or increased quantities, favor retention of water and mineral salts. Some of these investigators (Furstenberg especially) also eliminate or restrict the use of sodium chloride in the diet and substitute the potassium and ammonium salts instead. The precise action of the potassium is not known. Probably the diuretic action of the salt is an important factor in hastening the excretion of water and sodium chloride. Some believe that the nerve impulses of the labyrinth are increased and made optimum by the concentration of potassium in the fluid medium. There is no doubt that many cases have been helped and much improved by this method of treatment. However, Horton, who uses the histamine therapy, claims that 25 of his 49 cases had undergone some form of mineral treatment and obtained only palliative results and since they came to his clinic for histamine therapy, it indicated that they were not satisfied with the improvement.

(3) *Surgery*: Dandy of Johns Hopkins University, who argues that Meniere's Disease is limited to the 8th nerve root, believes that an operation to divide this nerve is the *only* permanent cure. He claims that some form of degenerative fibrosis is taking place in the nerve, either due to some lesion of the nerve cells in the brain supplying this nerve, such as tumors, compressing arteries, etc., or to some thickened arteries along the nerve which supply it with nourishment peripherally. Total division of the nerve destroys the remaining hearing; but he claims this is of little practical significance, considering the elimination of the severe attacks and the renewed comfort of the patient. Attempts to separate the vestibular from the cochlear portion of the 8th nerve have been met with some success, by him, in recent years. However, this division is extremely difficult, if not impossible, in most instances.

Division of both vestibular nerves, for bilateral Meniere's Disease, is attended by one rather surprising after-effect, viz., visual jumbling of objects when the patient is in motion; but as soon as the patient is at rest, the objects are again perfectly clear. This persists and remains permanent. This disturbance indicates the very intimate association between the vestibular and the visual apparatus in human beings.

(4) *Other Causes and Their Treatment*: There remains for me to mention the few less frequent causes and treatments of Meniere's Disease. (a) Northington describes a case of *Diabetes* relieved by diabetic treatment. (b) *Specific Allergy* has been given as a cause of sudden vasomotor disturbance in the labyrinth, and elimination of the offending allergens has been given as a relief from the symptoms. (c) *Endocrine "disturbances"* have been given as a cause. In one case of low basal metabolism, thyroid was given with relief for four years. When the attacks recurred, a low-salt diet and ammonium chloride was given and when this proved unsuccessful, section of the nerve gave complete relief. (d) *Vitamin* has been cited as an exciting cause in some cases, particularly Vitamin C. (e) Dandy claims that focal infection or systemic infections, such as syphillis and tuberculosis, are never exciting causes of Meniere's Syndrome.

In Conclusion: I feel that in most mild and moderate cases of Meniere's Syndrome, all forms of medical treatment should be tried first. If these fail, then surgery should be advocated. However, in some very severe cases, surgery is the one and only cure.

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ANISEIKONIA*

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Aniseikonia is a comparatively new arrival in the field of refraction. Serious work in aniseikonia dates from 1931, when the Department of Research in Physiological Optics at Dartmouth Medical School pioneered in the development of equipment and methods for measuring and correcting this condition.[1 2 3] To my mind this development is one of the few really significant advancements in our work since the recognition of astigmatism by Thomas Young, as a probable cause of ocular complaints. Aniseikonia is still, after eight years, inadequately understood and seldom considered by the great majority of refractionists. If thought of at all, it is usually dismissed as a highly complicated laboratory technique which has no practical bearing on the problems of refraction or orthoptics. Perhaps the use of cylinders was considered in a similar light not so many years ago. Of course, it takes time and study to readjust our ideas and techniques to these newer developments, but I am not alone in my conviction that aniseikonia is a very important factor in functional ocular problems. The correction of aniseikonia has proved its value as a clinical procedure in the relief of ocular discomfort and in certain types of orthoptic problems, but even its clinical applications have not been fully developed. Experimental and analytical studies of the factors underlying aniseikonia have led to important additions to our knowledge of the fundamental problem of binocular vision and the perception of space. Some experimental evidence seems to indicate the presence of a hitherto unsuspected adjustment of the eyes in binocular vision. Aniseikonia and its related phenomena promise to give us an entirely new concept of binocular vision so different from our traditional concept that we sometimes use a new word for it, horoptic vision.

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Before entering into a discussion of these new things which have come out of the work in aniseikonia,[9] I should like to briefly review our clinical methods and define some of the terms we use, so as to avoid possible misunderstanding.

The term aniseikonia, like most of the terms used in refraction, is derived from the Greek, ikon being the Greek word for image. We define aniseikonia for our purposes as that condition wherein the ocular imagine of one eye differs in size or shape from the ocular image of the other eye. This definition is very likely to be misunderstood, however, if we do not know the precise meaning of two of the terms used in it, i.e., ocular image, and size. The term, ocular image, is one of three terms which are very easily confused, so I should like to digress for a moment to differentiate between these three terms, retinal image, visual image, and ocular image.

The *retinal image* is the actual optical image which falls on the retina of the eye. It is similar to the optical image which falls on the photographic emulsion in a camera. It is a purely physical or geometric entity, and may be very different from the end result of vision as the photographic image is very different from the finished photograph. The *visual image* is a mental image. This term is reserved by the psychologist to refer to the image of recall. It is what you "see in your mind's eye" when you are asked to think of what a specific object looks like. The visual image is a purely psychological entity, and the important thing to remember about it is that it is the result of previous visual experience. The *ocular image*, which we refer to in our definition of aniseikonia, is the instantaneous projected visual sensation which unlike other sensations is precisely localized directionally in space. It is the result of the retinal image which exists at that particular instant as modified by the mental process of perception. Thus it is a present visual experience based on both geometrical and psychological factors. The importance of this distinction between retinal and ocular image is that it places the problem of aniseikonia in the field of visual perception rather than in the field of geometrical optics.

The other term in our definition of aniseikonia which requires some explanation is *size*. It would be possible to measure the size of ocular images in any of the various ways that have been used in dealing with the size of projected images in optical systems, but in any case it would be necessary to state explicitly the method used, i.e., units, points of

reference, etc. Since we are primarily concerned with differences between the size of the two projected images, the most convenient method is to use relative units of angular size referred to some specific point. Our system of comparing the relative size of ocular images is to use per cent angular size difference (angular magnification to equalize) referred to the assumed anterior nodal point of the eye. Reduced to simpler terms then, aniseikonia is a difference in the apparent size of the projected visual sensations of the two eyes, measured in percent angular magnification at the assumed nodal point of the eyes.

Clinically we find it convenient to use two qualifying terms for magnification, overall and meridional. These two terms are similar to the dioptric terms sphere and cylinder in that overall magnification refers to magnification in all meridians, as a sphere, while meridional magnification refers to magnification in one meridian at right angles to the axis of the meridional magnifier. Iseikonic lenses are lenses of known relative magnification designed to equalize the ocular images as well as to correct refractive error. We frequently refer to the power or the size of such lenses meaning the dioptric power and the magnifying power respectively. We often use the term size lens to mean an iseikonic lens having a specific magnifying power, but no dioptric power. Such lenses are used in testing for and measuring aniseikonia. The magnifying power of any ophthalmic lens is determined by four factors, dioptric power of the lens, position of the lens before the eye, base curve of the lens, and thickness of the lens, which are somewhat modified in near vision by a distance factor. In designing the iseikonic correction these four factors are modified to give the desired relative magnification without altering the effective dioptric power.[7]

The ophthalmo-eikonometer is the name of the instrument used in measuring the relative size of the ocular images. It is essentially a Wheatstone stereoscope whose mirrors are only half silvered permitting both direct and indirect vision. Such a device is often called a haploscope. This feature of the instrument permits us to measure the refractive condition of either eye alone while both eyes are engaged in binocular single vision under visual conditions approaching normal. This is accomplished by means of small targets whose reflected images move along the visual axis of either eye and are seen as distinct points only when placed in the far-point of the eye. The instrument is also equipped with charts for measuring phoria and visual acuity. The heart of the instrument, however, is

the eikonic screen at a distance of either twenty feet or sixteen inches. One type of such a screen has a central black fixation or fusion target about six inches in diameter. Four degrees from this in the vertical and horizontal meridians are four tiny holes in the screen. Behind these holes are lights placed slightly to one side so that they can be seen by only one eye of the patient looking through the instrument. The patient looking at the screen, then, sees the four holes as bright lights with one eye and as black dots with the other eye. If there is a difference in the relative size of the ocular images, it will become apparent as a disparity in the relative positions of the lights and dots. For instance, if the right eye is seeing the lights, and the patient reports that the upper light is above the dot while the lower light is below the dot, we know immediately that the right eye is seeing this vertical dimension larger than the left eye. To measure the degree of aniseikonia we would apply size lenses having magnification but no dioptric power until we had equalized the ocular images as reported by this criterion. Clinically the technique of obtaining accurate measurements is somewhat more elaborate than this and is complicated by the tendency of most patients to see the images equal over a range of magnification values. We speak of this tendency as the size amplitude. Our measurements are always made at both far and near and we frequently find differences between these two measurements.

In the beginning of this work on aniseikonia there was only one really new thought. That thought was the concept of the ocular image as described above. Previous to that time perception of size had always been thought of in terms of the retinal image, and to this day standard text books in optics discuss spectacle magnification in terms of the retinal image. This had given rise to some misconceptions notable among which is the idea that the magnification of any spectacle lens is always reduced to unity when it is worn at the anterior focal plane of the eye.

As soon as an attempt was made to search out the fundamental nature of aniseikonia the problem of retinal correspondence was met with. This led directly into investigation of the longitudinal horopter.* So the first outgrowth of aniseikonia was a comprehensive experimental and mathematical study of the longitudinal horopter. This in itself is a

*The longitudinal horopter may be defined as—

(1) The locus of the intercepts of the projections of corresponding retinal points.

(2) The locus of points seen in single binocular vision while the eyes are fixating a centrally located point.

(3) The locus of points which appear as though they were situated in a frontal plane, a plane which is parallel to the face through the point of fixation.

contribution of first rank to the body of knowledge about binocular vision, for it not only gave us a new analytical method of studying the horopter, but gave corroborative evidence of the presence of aniseikonia in certain clinical cases, and pointed the way towards studying the ways in which differences in size of ocular images may possibly influence our perception of space.

The perception of space is a tremendous problem which is by no means well understood as yet. However, some very interesting and promising things have already come out of investigations along this line. The normal horopter is a curve which is approximately tangent to the frontal plane at the point of fixation. In a subject who has aniseikonia or in one who wears a size lens which artificially creates aniseikonia the horopter is rotated around the point of fixation away from the eye which receives the larger image (i.e., the horopter is tilted). Since the points lying in the horopter are normally interpreted as lying in the frontal plane, this suggests that differences in the size of ocular images should produce changes in our binocular perception of the orientation of planes in space. A simple method of studying the disturbances of spatial perception introduced by aniseikonia is to use a tiltable plane which can be set so that it appears in the frontal plane and its actual position when so set would then indicate the deviations from normal. An instrument such as this has been in use at Dartmouth for several years and studies with it have been very fruitful.[6 12 13] The one outstanding contribution of the tilting plane is that it revealed the "induced effect." When lenses which magnify only in the horizontal meridian are placed before one eye of a normal subject an apparent tilt of the plane is to be expected and can be completely explained geometrically. However, when a lens which magnifies only in the vertical meridian is used there is no geometrical reason to expect an apparent tilt of the plane. The amazing fact is that in a great majority of the cases studied a tilt was found to result when the relative size of the ocular images was altered in the vertical meridian. The only explanation of this phenomenon yet offered is that the change introduced in the vertical meridian is compensated in part by an overall change which takes place somewhere within the ocular mechanism, and the residual difference in the horizontal meridian accounts for the so-called induced tilt. Whether this adjustment takes place in the primary brain centers or elsewhere is not known. There is some evidence which points toward the possibility that this adjustment is dioptric, though to my mind this seems the least acceptable answer. Some recently published material on this subject shows

under what conditions this induced effect may take place, but still does not offer an answer to where or how it is accomplished.[12 13]

The induced effect was found to depend to a large extent upon the presence of a fusible pattern in the vertical meridian. This gives rise to the thought that peripheral fusion stimuli may be of more importance than has been hitherto realized. With this in mind studies have made on the effects of peripheral fusion stimuli on central fixation.[14 15] One surprising result of this study was that it was found that under proper circumstances peripheral stimuli may prevent central fusion in perfectly normal subjects where no appreciable muscle imbalance was present. This may have useful applications in the field of orthoptic training when it is better understood.

It has been found in studies made with the horopter instrument, the tilting plane, and a haploscope device[9 11] that under conditions of asymmetrical convergence (eccentric fixation), a curious adjustment is made in the relative size of the ocular images, which partly compensates for the actual difference in angular size which exists by reason of the geometrically different disposition of the eyes with respect to the eccentric point of fixation. The findings obtained by these different methods are somewhat contradictory at the present time, but we may hope that as these studies are carried further they may lead us closer to an understanding of the true nature of this size adjustment of the eyes in binocular vision.

From the very first the correction of aniseikonia by means of iseikonic lenses presented a unique problem in ophthalmic optics. The mathematical solution of this problem has been a distinct contribution, a highlight of which was the recognition of the fact that spectacle magnification is comprised of two distinct factors, a power factor dependent upon the power and positions of the lens, and a shape factor dependent upon the base curve and thickness of the lens.[7] A further problem was presented in grinding these lenses to the very low tolerances demanded. The solution of this problem was a triumph of lens grinding. It required the development of special machinery to overcome the inaccuracies of ordinary lens grinding equipment in dealing with cylinders on moderately high base curves. Along with the need for such accuracy in calculating and grinding the lenses came the demand for a device for testing the lenses with extreme accuracy for both dioptric power and magnifying power, so a highly refined testing instrument was designed and is used

on every iseikonic lens that is made. It is now possible through these developments, to grind saddle shaped lenses with toric curves inside as well as out whose axes coincide exactly.

Considerable improvement is to be expected in clinical methods of measuring aniseikonia. Polaroid offers a simple solution to the problem of presenting dissimilar targets to the two eyes simultaneously, while both are engaged in normal binocular vision. The form of the target could be improved in several respects particularly in providing better control of fusion, and in making possible more accurate discrimination of disparities. It is possible that the use of peripheral fusion targets with central fixation of the eikonic targets will provide a more accurate method in certain types of cases. It is to be hoped that methods will soon be devised for comparing the ocular images in oblique meridians, although this poses problems that are by no means simple. A most important development yet to be accomplished is the adaptation of these methods to squint cases where fusion is difficult if not impossible and the angle of squint requires a wide latitude in the adjustment of the instrument. When we point out these shortcomings of our present equipment it seems surprising that we have found it useful at all, but the fact remains that we are able to relieve discomfort in over seventy per cent of the cases who have worn iseikonic correction.[10]

The earliest concept of the clinical value of the correction of aniseikonia was simply for the relief of ocular discomfort and headaches of unexplained origin. As our experience in this field has increased we have come more and more to the belief that aniseikonia plays an important part in fusion problems and squint cases. Isolated cases where marked improvement in fusion and depth perception have followed the correction of aniseikonia tend to support this view. There is at least one case reported in which the vision in an amblyopic eye improved remarkably after correction of aniseikonia.[14] This suggests interesting possibilities. In the past few years we have heard much about reading disability in the schools. There are some indications that aniseikonia may play a part in inhibiting the development of normal reading habits.

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ASTIGMATISM*

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Introduction:

Whatever small contribution I have been able to make to the sum total of optometric knowledge has been from the point of view of "end results" from the practice thereof. This paper is in keeping with my role.

The subject of astigmatism has been chosen with the thought in mind that the correction of an optically oblong image when found in the refraction of the human eye is among the most important things we have to do.

Rationale:

The human eye is far from a perfect optical instrument at best, but when there is astigmatism present the image thrown upon the retina is so poor that were the same image focussed upon a film in a camera the photographer could never retouch the picture so that it would look like anything he had desired.

And my particular point is that the human mind, like a retoucher of photographs, has either to accept poor pictures and rectify them or else try to do something about the image through re-focusing the picture taking mechanism.

When there is astigmatism present in the refractive apparatus of the eye, the retina must accept a line focus or an oblong image.

The mind in turn has its choice of accepting it "as is" or doing something about it. Just what can be done has been the subject of considerable thought by many men. Sectional accommodation has frequently been set forth as the answer. While admitting the possibility of such a thing I do not subscribe to the theory of sectional accommodation. Such is possible because I have had definite evidence to that effect, but it does

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not appear to me that the focal apparatus of the eye by the nature of its construction was ever intended to do the things such an action calls for.

In the old text book, Thorington's *"Refraction and How to Refract,"* appears the following statement: "Furthermore, it is possible, with a drug like homatropin, if not properly used, to have some of the sphincter-fibers become paralyzed while others may remain free to act. In this way a spasm of the ciliary muscle may be produced that will give a false astigmatism." . . . "Homatropin as cycloplegic should be held in reserve for individual cases, and not used as a routine practice. It is a good, reliable, paralyzer of the accommodation in many eyes at the age of thirty-five, or thereabouts; but in a young hyperopic eye it is a waste of time to attempt successful paralysis with it, and the danger of producing a false astigmatism should certainly deprecate its use in these cases."

Some time ago a hysterical child was brought to me by her mother, because a physician had attempted to instill a weak solution of homatropin in her eyes. The nurse had used but a small amount in the right eye when the child began to cry, hold her lids tight shut and make a scene. They came right over to my office and after quieting her down was able to do a static and a short subjective. There was practically one diopter of astigmia which was not there on later tests, in fact the small error found and worn was at the reverse axis.

Premise:

It is my purpose to argue the point that the mind attempts to neutralize astigmia by direct, all around normal straight-forward accommodation and in so doing uses a tremendous number of additional neuromuscular impulses to find a usable focus. It is my premise that one-half diopter of astigmia causes in the neighborhood of one and one-quarter diopters of additional focal impulse use.

End Result Evidence:

If the patient is hypermetropic and has one-half diopter of astigmia and in seeing corrects the hyperopic error simply to the point of minimum focus then the image is blurred by one-half diopter of hyperopic astigmia. If this is corrected to the other end of the image then there is one-half diopter of myopic astigmia. But in between these two points is the area of best vision and it is my belief that persons having astigmia, together with good vision, find and use this interval of sturm for seeing.

It is certain that something is done about it because persons are found who can read 20/20 letters through high errors of astigmia. There is an optometrist in Los Angeles whose naked vision was 20/20 for

years and now wears O.U. —2.25 D. Sph. ⊂ +4.50 D. Cyl. axis 90. All practitioners have had patients with errors as high as two diopters who could pass 20/20 or 20/30. That patients do focus first one end of the astigmatic error and then the other is proved when a hyperope with astigmatism is shown an astigmatic dial and reports "The vertical lines are darker—no wait a moment—the horizontal lines have come out better." This phenomenon is more often observed at the near point on the cross cylinder grid—first one set of lines come out, then the other with a final report—"Wait a second, now they are all alike." It is my opinion that this observable phenomenon is made possible through the direct action of normal accommodation without recourse to sectional accommodation.

Optical Proof:

Given a source of light, a screen upon which a beam of light can be focussed and a spherical lens with which to draw a focus a small round image can be shown at the focal point. Place a plus power cylindrical lens before the spherical and a band focus will be had with the line opposite to the axis. Move the combination in the direction of the screen and the image will become round, though of course larger than before because there is no longer a spherical point of focus. Moving the combination still closer to the screen the band of focus will appear along the axis of the plus cylinder.

Demonstration:

Such a combination of sphero-cylinder power is glued to the slide through which I will project an image upon the screen. There is a source of light, a sphero-cylinder lens, a condensing lens and the screen. Note that the image is oval. By moving the condensing lens forward the image is made round and a still greater forward movement brings an oval opposite to the first image. The use of letters in conjunction with this combination proves that at the point of round image the letters are somewhat legible while at all others they are obscured.

Solution:

It therefore behooves an optometrist to correct every last vestige of astigmatism before he writes a prescription for a correction. The small errors are of extreme importance and when a large error is partially corrected it naturally follows that a small error is now existent and the patient's suffering may be even greater than before. This idea is given strength by a comparison to other normal acts of life. The accommodative correction of a high error is like reaching for something which is

almost, but not quite, out of reach. One only reaches for such when extreme necessity arises. But if an object is closer, within reach even though such takes effort, we will make that effort over and over again rather than do something about it. Small errors, therefore, are constantly compensated for and cause neuro-muscular use which would not be called for in the presence of large errors.

As an example of our reasoning that one-half diopter of astigmia causes as great, or greater use of focus impulse as one and one-half diopter of hyperopia, suppose a person with such an error wishes to investigate a minute object. First one end of the image is focused, then the other, and finally the compromise round image, the interval of Sturm, is found and held. When I say "and held," think of a person standing with difficulty on tiptoe, balancing backward and forward and you will have my impression of what happens to a compensated image thus focussed. There was first one "correction" made which called for the normal focal effort were the image round, then another focal adjustment and the final one, or who knows, maybe more when the mind is keen and the patient interested. This is the gist of my presentation.

If this happens, and from the observable evidence at hand it seems reasonable to suppose that it does, then the over use of focal impulses may very well bring on the typical syndrome of symptoms associated with "accommodative insufficiency" even though the amplitude of accommodation can be proven to be ample. And in my opinion this is just what happens.

We recently had a case of a stenographer in a law office, who was forced to use her eyes beyond normal endurance. The findings were as follows:

Case No. 1

Age 24. Chief complaint, eyes burn and smart. Frontal headaches. Distance objects blur badly after a day of work. Phoria Esophoria 2 P.D. Lag of Convergence Eso. 4 P.D. Vision P.R. O.D. 20/30— O.S. 20/40 P.P. 20/20— Ophthalmoscope. Negative.

Ophthalmometer. O.D. 45.00 X 46.00 X 90. O.S. 45.1 X 46.2 X 90.

Static. O.D. —0.25 —1.00 X 180. O.S. —25 —1.25 X 180.
Dynamic add O.U. +1.00.
Subjective O.D. —1.25 X 180. Va. 20/20+. O.S. —1.25 X 180. Va. 20/20+.

Phoria. Eso. 2. P.D.
Base out test X/24/18.
Base in test 8/5.
Lag of convergence Eso. 2 P.D.
Unfused cross cylinder add +1.00 with Exo. 2 P.D.
Fused cross cylinder add +0.50 with Ortho.
Base out test X/20/8.
Base in test 15/22/18.
Minus lens blur-out point add —2.50 Eso. 8 P.D.
Plus lens blur-out point add +1.50 Exo. 4 P.D.
Positive amplitude O.D. 8 D. O.S. 8.50 D.
Negative amplitude each +2.00 D.
Keystone. Series 100%. Adult series 60%.

It seemed rather queer to be fitting minus cylinders to a girl in such a position but we reasoned that if our philosophy were correct the accommodative impulse use would be cut in half or more and that her normal reserves were ample to carry on in normal fashion. Here are her near-point findings at the end of three weeks when she came in for the progress report.

Subjective O. D. —1.25 X 180. O.S. —1.37 X 180.
Phoria Eso. ½ P.D. Lag of convergence Exo. 3 P.D.
Base out test X/24/16. Base in test 8/6.

P.P. Unfused +1.25 Exo. 7 P.D. Fused +0.75 Exo. 5 P.D. Base out test X/22/15. Base in test 16/24/20. Add —2.75 Eso. 4 P.D. Add +2.00 Exo. 9 P.D. Adult stereopsis 80%. The headaches are no longer a problem and the patient is perfectly comfortable.

Such a case carrying on without glasses would no doubt have compensated for the Esophoria and later become a suspenope and Exophore. We put this philosophy to test with the following case.

Case No. 2

Miss B. came in with the chief complaint of constant headaches, drawing feeling in the eyes, epiphora redness of the lids, nausea, etc. The vision was O.D. 20/20— and O.S. 20/30. Habitual phoria Exo. 3 and convergence lag of Exo. 10. Stereopsis demonstrated on flat and stereo cards but could not pass the Keystone child's series. Eyes deviated under paralax, the push-up for convergence was poor but ample for accommodation. Rotations were very jerky and erratic while the versions were limited and she was a decided head-turner.

Ophthalmoscope negative.

Ophthalmometer. O.D. 42.1 X 43 X 100. O.S. 42.00 X 43.00 X 80.

Static O.D. +0/50 +0.75 X 100. O.S. +0.50 +1.00 X 80.
Dynamic add +1.25 O.U.

Subjective O.D. +0.75 +0.75 X 100 Va. 20/20. O.S. +0.75 +1.00 X 80 Va. 20/20.

Phoria Exo. 2. P. D. Base out test X/18/12. Base in test 10/6.
P.P. Lag of convergence Exo. 11 P.D.
Unfused cross cylinder add +1.50 Exo. 16 P.D.
Fused cross cylinder add +1.00 Exo. 16 P.D.
Base out test X/15/9. Base in test 12/24/20.
Add —2.25 Exo. 4 P.D. Add +2.25 Exo. 18 P.D.
Positive amplitude O.D. 7 D. O.S. 7.25 D.
Negative amplitude O.D. +2.50 D. O.S. +2.75 D.

Considering the fact that this girl at age 22 had never worn glasses or had her eyes examined even though she gave a history of being an omnivorous reader, we felt that if it was only normal we should find an exophoria as well as a high lag of convergence. We also reasoned that when two such eyes are associated together and integrated into a binocular function there must of necessity be a tremendous number of focusing impulses used to hold an adequate focus while the adduction has need for only a normal output of neuro-muscular energy. The adduction, however, must keep step with the focus because of the two, clear vision and single vision, clear vision is the first essential in seeing.

The cause of the exophoria, then, we reason to be directly attributable to the over-use of focus. Relieve this condition and the response will be a lowered phoria and more efficient team work. The subjective correction was given without recourse to orthoptics and the progress report examination was: Phoria Exo. 1 P.D. Lag of convergence Exo. 7 P.D. Comfort was had and more efficient seeing all around. Keystone adult stereopsis 20%.

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COMMENTS ON THE BETTS STEREOSCOPIC VISUAL ACUITY CHARTS

The Telebinocular is a useful diagnostic instrument, particularly of value in making visual surveys and in certain orthoptic procedures. It is becoming increasingly evident, however, that the Betts DB1, DB2 and DB3 cards as used with this instrument in taking visual acuity, both monocularly and binocularly, are subject to some legitimate criticism. Particularly so, if these cards are used for more than simple visual screening.

Before the American Academy of Optometry in 1936, William J. Tait[1] presented the results of an investigation made to determine the

[1] Tait, William J. A Clinical Study of the Validity of a New Procedure for Measuring Visual Acuity. American Journal of Optometry. 14, 8, 302-307. 1937.

validity of the Telebinocular as an instrument for the determination of visual acuity. In conducting this study 439 selected subjects were used. The acuity of vision of these subjects as taken with the A.M.A. Snellen Visual Acuity Chart at 20 feet, with controlled illumination, was compared with that of the same subjects using the DB1, DB2 and DB3 series of Betts stereoscopic visual acuity cards. Tait found that these cards had a tendency of giving the subject a higher visual acuity reading than did the conventional Snellen method.

In 1939, Molish and Reese[2] presented the results of a similar investigation made at Ohio State University, this again to determine the validity of the Betts tests when these findings are compared with those of the standard Snellen visual acuity chart. In this study 69 subjects were used and again the investigation indicated that the Betts visual acuity readings were higher than the same visual acuity readings taken with the Snellen chart.

Last year, Fry[3] conducted an investigation to again determine discrepancies between the Betts cards for recording visual acuity and the Snellen charts used for the same purpose. In this investigation 89 grade school students were used as subjects and the actual scores were recorded and studied. In this third investigation the Betts findings were again found to average somewhat higher than the findings taken with the Snellen chart.

The results of these studies indicate that the Betts DB1, DB2 and DB3 cards should either be redesigned to make the findings, as secured by their use, comparable to the standard Snellen chart, or that this particular set of stereoscopic cards be withdrawn from use. Perhaps the suggestion of Fry can be put into practice that the already available reduced stereoscopic Snellen Charts be substituted for the DB1, DB2 and DB3 Betts charts now in use.

CAREL C. KOCH.

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SPECIAL REPORTS

CONTROLLED RESEARCH VERSUS CLINICAL FINDINGS*

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A handicap which at times prevents optometry from receiving professional recognition in scientific circles, is our lack of both controlled and clinical research. It is the purpose of this paper to concisely explain methods of gathering visual evidence in such a manner as to insure reliable results that will be acceptable in scientific circles. This implies that suitable controls be established and used throughout each investigation. Perhaps it will be easier to explain the necessary procedures if I use the activities of the American Research Council of Optometry as an example of controlled investigation since, to my knowledge, this is the only organization conducting research within optometry that has used controls and followed procedures acceptable in psychology.

In commenting on research, Dr. Henry Wyman Holmes[1], Dean of the Graduate School of Education, Harvard University, says, "One could fill all the pages of this report with documented examples of duplication that is sterile and wasteful. It is the kind of duplication that results when an experimenter fails to read what has been done before, or fails to bring to a problem any new hypotheses or research techniques. It is of the nature of stereotypy; it is duplication without logical purpose, so far as the whole field is concerned. (That it may fill some private or professional need in the life of the researcher is another matter.) In armchair fashion, one could point out some reasons for such wastefulness. It is common to dwell upon these.

"1. Masters' theses and doctoral dissertations are fragmentary and opportunistic in nature. (The problem has to be small and clean-cut; carried on in the midst of a busy academic life; and brought to an early completion. There is a premium on safety.)—"The time factor is important. Longitudinal studies, for example, by definition require a long interval of time. Except in rather elaborate research institutes, it has not

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appeared feasible to get one person to work on a project for five years or more, or to get a succession of workers to articulate their findings longitudinally."

In view of Holmes comments, it is readily seen that we could not expect to get many qualified optometrists to work on a program for a sufficient length of time to exhaust the possibilities of the subject. This made necessary the selection of a Director of Research, whose duty it was to be thoroughly familiar with the work as it progressed and who would be able to start each new Research Fellow at the point where the previous optometrist had finished.

Since we in The American Research Council were concerned with reading, it was necessary to have an Advisory Board consisting of psychologists and educators as well as optometrists.

The first step in any investigation consists of the gathering of the evidence or the statistics. If new knowledge is to be expected from the investigation, it is necessary that other than the customary visual data be acquired, so it became necessary to canvass the professions of optometry and education to ascertain just what subjective or objective tests or observations might be expected to give information of value in regard to visual functioning in reading. As a result of this survey, it was found possible to make fifty subjective and objective tests on each subject.

The Controls Used in the Investigation: The only control which could be used in the investigation, was to make sure that each operator was perfectly competent to carry on his or her part of the work.

The Size of the Sample: In judging the value of any investigation, the size of the sample, or the number of subjects used, is a factor of vital importance. It must be kept in mind, at all times, that any investigation or research is more or less limited in scope, it being physically impossible to include the whole population in any investigation, so we must consider the number of subjects we work with as a sample of the population as a whole.

In our case, we used 2,100 students, ranging from kindergarten to twelfth grade, giving us just short of 200 subjects for each grade. All of the 50 subjective and objective tests were made on each of these subjects. This represented the evidence gathering stage of the investigation. With the evidence at hand, it then seemed desirable to ascertain if any of the visual factors considered, correlated with either scholarship or reading ability. This required that the evidence be statistically correlated.

Statistics: While the mathematics of statistical analysis are well within the capabilities of a person possessing sixth grade knowledge of mathematics, the subject of statistics is not customarily taught until the student has had four years of college work and has entered, what is termed the Graduate School of Education. This procedure is followed for the reason that statistics of themselves may be very misleading unless the student has had the necessary ground work of logic and scientific training so that he may properly evaluate the reliability of his own statistics.

Lindquist[3] as well as other authors of texts on statistics for beginners, stress throughout their writings that "statistically significant" means just what it says. It does not mean that an actual truth has been established. The co-efficient of correlation may be high, but there still may be a lack of reliability. The probable error, while statistically accurate, may differ widely from the actual errors included in the sampling study. So we see that much more than mathematical ability is required to give a true interpretation of statistical treatment.

In any case, it is advisable to have persons other than the ones who gather the evidence, compile the statistics since it is quite likely that the persons gathering the evidence will have acquired certain prejudices that might possibly affect the results.

In the case mentioned the statistics brought out clearly the point that the all important visual factor in reading was the fixation ability. Students in grade and high school possessing good fixation ability had an average reading speed of 265 words a minute, while the students with a defective fixation ability had an average reading speed of 185 words per minute, the critical ratio of the difference being 7+.

Since the critical ratio of 3, is considered statistically significant, we must consider the differences in this case highly significant, statistically. We have seen however, that statistics, regardless of how carefully the evidence is accumulated and how carefully the statistics are calculated, may lead us astray. The mere incidence of a high percentage of a certain visual anomaly among a certain restricted group of students may be due to chance. Other visual anomalies, perhaps as yet not considered, might very well be the controlling factor.

If a defective fixation ability, actually is responsible for retarded reading and lowered scholarship, it naturally follows that if the fixation ability can be improved, that improvement should be reflected in reading speed and comprehension. If through the improvement of the fixation

ability, we would get an improvement in reading speed and comprehension, these statistics could be considered reliable. On the other hand, if the improvement of the fixation ability did not show an improvement in reading speed and comprehension, these statistics would necessarily need to be considered unreliable.

VISUAL TRAINING DESIGNED TO IMPROVE THE FIXATION ABILITY AND ASCERTAIN IF THAT IMPROVEMENT IS REFLECTED IN READING SPEED

Having ascertained, from a statistical standpoint, that a defective fixation ability is the one important visual anomaly responsible for retarding reading, the next logical step was to ascertain if there were optometric ways and means of improving the fixation ability and if this improvement were reflected in reading speed and comprehension. Since we were adventuring into an entirely unexplored field, it was necessary to make a thorough review of all the known knowledge of physiology and psychology of vision, in order that the type of training procedures that could logically be expected to secure the desired results, could be tried out under controlled conditions.

Controls Established: In this stage of the investigation, much more elaborate controls could be devised and used. From past experience of psychologists and educators, we learned that persons of high intelligence, acquired new knowledge much more rapidly than persons of low intelligence, so it became necessary to consider intelligence as well as visual factors in the selection of our experimental and control groups.

Typical Example of Experiment No. 1: For this experiment, the entire freshmen class, in the Teachers College at the University of Nebraska, was given a full battery of mental measurements, including intelligent quotients, scholastic aptitudes, etc. This was done by the psychological staff of the college in addition to the customary optometric tests which were made by our Research Fellow. From this freshmen enrollment, three smaller groups, evenly matched for mental measurements and visual handicaps were selected.

Group "A" received a certain type of visual training that could be expected to improve fixation ability. Group "B" received another type of visual training that could be expected to improve fixation ability. Group "C" received the standard pedagogical training to improve the reading speed and comprehension. At the conclusion of the training period, all of the mental measurements as well as the visual measurements were again repeated and compared with the initial tests. It is seen that in

this particular experiment, it was possible to get a fair comparison of the two different types of visual training used and also a comparison of the results to be expected from optometric visual training as compared to pedagogical training.

Typical Example of Experiment No. 2: The purpose of this experiment was to arrive at a fair estimation of the value of visual training as compared to pedagogical training, and ascertain if the subjects used in the experiment made greater or less gains in reading speed than subjects who received no special training in reading.

For this experiment, the mental measurements and visual measurements were made in the exact manner as used in Experiment No. 1. Three matched groups were selected from the main student body; Group "D" being the experimental group to receive a certain type of visual training; Group "E", the experimental group to receive pedagogical training; Group "F" to attend classes in the routine manner without any special training to improve their reading speed and comprehension. At the conclusion of the training period all of the mental and visual measurements were again repeated, permitting us to arrive at certain conclusions as to the comparative value of the different procedures used. These two examples should be sufficient to illustrate the need for, and how to secure reliable evidence from, controlled experiments.

Personality of the Operator: In order to avoid the influence of one personality and in order to devise training procedures that might be expected to produce the desired results for the profession as a whole, we have used twelve different operators during the five year period of controlled research.

Probable Errors in Measuring Gains in Reading Speed and Comprehension: From the statistical standpoint, a gain of twenty-five or thirty words per minute might be considered significant for certain cases. Human beings, however, are subject to moods and emotions and cannot be expected to conform to mechanistic or mathematical formula. Hence, we may expect a day to day variation in the reading speed and comprehension, due solely to the physical and emotional condition of that particular subject at that particular time.[4]

Through making 3,000 reading tests on 50 subjects over a period of one school year, it was found that in order to be conservative, we must have gains of at least 100 words per minute for university freshmen before we could consider that there was an actual improvement in

reading speed and comprehension. Lesser gains than this have been counted as failures or no improvement. It might be interesting to add that in some types of visual training used, as high as 95 per cent of the experimental group have shown improvements of from 100 to several hundred words per minute. Other types of visual training have shown as low as 30 per cent of the subjects making significant improvement, so in speaking of the values of orthoptics for the improvement of reading speed, we must be very specific and state the particular type of visual training used.

Values Derived From Controlled Group Training: From controlled group training, we can expect to arrive at broad, general principles for improving visual functioning. It is expected that a larger percentage of failures will result since each individual in the group cannot be expected to respond to a certain type of training in like manner. The advantages, however, more than offset any disadvantages since in this type of an experiment, it is possible to bring in subjects who are not visually uncomfortable or visually conscious and it is further possible to derive comparative results of different types of training.

Suggested Improvements for Conducting Controlled Research: Optometry could profit greatly through the establishment of a centrally located, well-staffed, permanent laboratory, that could investigate all phases of visual anomalies and correlate all types of visual training, with all types of visual corrections. This laboratory would not necessarily be competitive to the American Research Council of Optometry, since there is considerable evidence to show that different diagnostic procedures as well as different training procedures, are and will continue to be required for different sections of the United States, owing to the different climatic and the different dietary conditions.

CLINICAL RESEARCH

While it is not possible to secure evidence from clinical investigations that can be readily accepted as reliable in scientific circles, this type of investigation does occupy a highly important place in the research picture for optometry if given its true value.

Since we seldom find two cases of squint wholly alike, it would be impossible to establish controls in an investigation of squint. One person may be wholly comfortable with a certain percentage of difference in the size of the retinal image while the same visual anomaly may make another

person quite uncomfortable. So we see, it would be out of the question to conduct controlled research in aniseikonia.

Advantages of Clinical Research: In clinical research, we have the advantage of closer supervision of each patient. We can make frequent checks of the progress and can vary the training procedure according to the response of the particular individual receiving the training. In this type of an investigation, it is also possible to give each person closer personal supervision.

Disadvantages of Clinical Research: The available subjects for clinical research are, in the main, persons who are visually uncomfortable or visually conscious and hence, cannot be considered as truly representative since we have no means of knowing whether or not other persons with like visual anomalies are entirely comfortable and visually efficient.

Another factor of importance is the personality of the operator giving the training. Perhaps one individual may be able to secure wholehearted cooperation from the patient and through this cooperation, secure highly significant improvement. Another operator using the same training procedure on the same individual conceivably might make a total failure.

Another disadvantage to clinical research is the fact that we do not have enough patients of the same type and are not equipped to make the desired mental measurements as well as the desired visual measurements.

The Values Derived From Clinical Investigation: Owing to the impossibility of establishing scientific controls; to the personal supervision of the operator, and to the possible favorable bias of the operator, the results of clinical research cannot be readily accepted as evidence in scientific circles. In spite of this criticism, there are great values to be derived from clinical research. For certain types of visual anomalies, it is wholly impossible to establish the desired controls or to secure the desired number of patients; hence, we must continue to encourage and support clinical research throughout optometry. It is from clinical research that we can get our leads for conducting controlled investigations.

The Cost of Research: According to Holmes[2] "So far as research subventions are concerned, the sponsorship of staff members, and of the institution as a whole, would appear to be important factors. Practically, this means that in assigning fellowships to doctoral or postdoctoral candidates, attention should be paid not only to the capacities and interests

of the candidate, but to the institution where he proposes to carry on his work.

"In all programs of research a balance sheet should be struck. There is on the one hand the immediate cost of the research in terms of salaries, stipends, materials, transportation, and publication. So objective and visible are these elements that often we regard them as a complete statement.

"But there is, on the other hand, the estimated cost of not carrying on the research. For example, in the field of delinquency and crime Senator Copeland's committee estimated that the total cost per year in the United States was eleven billion dollars. This figure seems incredible, yet it was based upon careful estimates made by disinterested persons. Even if we were to reduce it radically, the total cost of institutional care, police force, criminal court, loss of life and property, insurance, and unemployability would be tremendous—comparable only to the prosecution of a first-class war. The question then becomes this: What percentage of our national wealth might be earmarked as research funds, with the hope that increased knowledge would reduce the total cost, whether the estimate be in dollars or in human suffering? So long as objective inquiry, ranging from rigorous experimental research to enlightened clinical procedure, holds out any hope whatever for amelioration in such conditions, we are justified in asking for large-scale expenditures."

The American Research Council of Optometry finds that it can maintain laboratory facilities and adequately support one Research Fellow in a recognized university in the middlewest or west for approximately $1,500 to $3,000 per year. We have estimated that a central, well-equipped, properly staffed, laboratory could be established for as little as $50,000 and could be operated for as little as $15,000 per year. It would be necessary to provide that the operating expense be increased as rapidly as the expansion of the investigation occurred. Probably within a few years, an expenditure of $50,000 a year could be profitably used for the operation of one well-staffed, well-equipped, centrally located laboratory.

While these figures may seem high, there is evidence which shows that optometry is spending many times this amount each year because of improper professional recognition and relationships caused in part by the lack of new knowledge that can be expected to be derived from unbiased investigation of visual problems. It is regrettable that optometry is today

one of the very few professions without an adequate and far reaching research program.

REFERENCES

1. American Council on Education Studies, Educational Research November 1939, Series I, Volume III, Number 10, Page 44. Published by the American Council on Education, 744 Jackson Place, Washington, D. C.
2. Ibid, Page 49.
3. First Course in Statistics by E. F. Lindquist, Professor of Education, State University of Iowa, Pages 24, 68, 124, 126, 182.
4. Ibid. Page 196.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

by J. Fred Andreae, Secretary

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

PROFESSIONAL STATIONERY

It has been suggested that the Secretary say a word or so in this department about the lack of uniformity in letterheads used by Fellows of the Academy. Probably little thought has been given this important item in the professional life of our members. In arranging the format of one's stationery it is not considered necessary to itemize the various techniques and services offered by the optometrist.

The following suggestions are offered for the consideration of members: Stationery, to be effective and in harmony with professional practice, must be run on good stock and must be well printed or engraved. The format should contain but three things. These are: (1) The name of the doctor, followed by the single word—Optometrist; (2) the office address and name of city; and (3) the doctor's telephone number. The latter can be expressed properly in one of two ways: (a) "For Eye Examination, Phone Calvert 3843," or "For Appointment, Phone Calvert 3843."

The first and second of these items are usually centered near the top of the sheet with the third item at the upper left corner of the page.

Fellows of the Academy may also use, should they desire to do so, the words "Fellow of American Academy of Optometry." These can be

placed in the upper right corner of the sheet, thereby effecting a typographical balance. While it is not essential that this latter be included in one's stationery, it is considered in good taste.

DATES ANNOUNCED FOR ANNUAL MEETING OF ACADEMY

The dates for the coming annual meeting of the American Academy of Optometry are hereby announced as December 7, 8 and 9, 1941. The meeting will be held at the Hotel Morrison, Chicago, Illinois, and all Fellows of the Academy are expected to attend.

Dr. Dan Hummel, Chairman of the Program Committee, Guardian Building, Cleveland, Ohio, reports the program is almost completed and is one which will interest the scientific as well as the practical mind. Two additional papers are required to fill the program for the entire three-day period. Members wishing a place on this program should get in touch with Dr. Hummel immediately.

ABSTRACTS

A department in which will appear abstracts of the literature of optometry, ophthalmology and applied optics. These will be classified according to the following list, although contributions to all sections will not necessarily appear in each issue.

1. Ocular **Refraction.**
2. Physiological Optics and Color Vision.
3. Ocular Muscles.
4. Orthoptics and Reading.
5. Anatomy, Histology and Embryology.
6. Ocular and General Pathology.
7. Ophthalmic Lenses and Material.
8. Instruments.
9. Hygiene and Illumination.
10. Applied and Physical Optics.
11. Education, Sociology and Economics.
12. Miscellaneous.

1. OCULAR REFRACTION

VALIDITY OF PHORIA MEASUREMENTS WITH A STEREOSCOPE. Fry, G. A. Optometric Weekly. 1940, 31, 18, 516-519.

Fry conducts a series of investigations as to the validity of measuring the phorias at both distance and near with the telebinocular, using the DB9 Betts card. His findings lead him to the following conclusions (1) the telebinocular phoria test at infinity gives a measure of proximal convergence added to tonic convergence but when taken by itself provides no method of determining the amount of tonic convergence or of measuring the amount of proximal convergence involved. (2) The telebinocular

near point phoria test cannot be regarded as a valid method for measuring the amount of fusional convergence which would be needed for single vision at the subject's normal working distance.—C.C.K.

A SUBJECTIVE ASTIGMATIC TEST. Aronsfeld, G. H. Optician, (London), 1940, 100, 2579, 54-55.

Aronsfeld developed a subjective astigmatic dial, which is a combination of the rotating crossed lines of Lancaster and the astigmatic V of Verhoeff. In Aronsfeld's dial the V is inverted and placed at the end of one of the movable crossed lines. This device then revolves within a clock dial. Aronsfeld has used this subjective astigmatic dial with success for a number of years. His article reviews the subjective techniques which he uses in measuring the axis and amount of astigmatism.—C.C.K.

FUNDAMENTALS IN THE CORRECTION OF SUBNORMAL VISION. Greenspoon, R. Optometric Weekly, 1940, 31, 23, 649-652.

Greenspoon presents in outline form the common causes of subnormal vision and the various sub-normal visual aids which may possibly assist these cases. The author stresses the need for a period of visual re-education which must accompany the use of these aids to sub-normal vision.—C.C.K.

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2. PHYSIOLOGICAL OPTICS AND COLOR VISION.

A STATISTICAL ANALYSIS OF STEREOPSIS. Cash, H. Optometric Weekly. 1940, 31, 21, 600-601.

Eighty-two students were examined by means of the telebinocular and accompanying cards. The purpose of the investigation was a study of stereopsis. As a result of his correlations of findings, Cash comes to the conclusion that stereopsis is not a function of ocular mechanism but is an independent function.—C.C.K.

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4. ORTHOPTICS AND READING.

ORTHOPTICS. Kinsley, E. V. Canadian Journal of Optometry, 1940, 2, 7, 207-211.

Kinsley presents several detailed clinical reports in which a case of divergent squint; a patient with a convergence insufficiency; an accommo-

dation problem case; a case of fusional imbalance, and an alternating esotrope were treated by various orthoptic procedures. In general, each of these cases has shown some improvement. The refractive data is presented in accordance with the nomenclature of the Optometric Educational Program.—C.C.K.

BINOCULAR ANOMALIES AND READING ABILITY. Clark, Brant. American Journal of Ophthalmology, 1940, 23, 8, 885-891.

Clark reviews the literature of reading abilities and binocular abnormalities and comes to the conclusion that visual defects in general and binocular anomalies of vision in particular have little do do with making patients good or poor readers. It is suggested, however, that visual defects when present should be corrected as part of any fundamental remedial reading program. A full and valuable bibliography is included.—C.C.K.

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6. OCULAR AND GENERAL PATHOLOGY.

PERCENTAGE OF OCULAR PATHOLOGY. Borish, I. M. Indiana Optometrist, 1940, VIII, 6, 3-4.

Borish presents a report on ocular pathology based upon cases examined at the clinics of the Northern Illinois College of Optometry at Chicago. The total number of patients examined in the period covered by the report was 2,352. Of these only 198 or 8.4 per cent showed evidence of ocular pathology. Of these 198 cases, 86 had evidence of cataract in some stage of development while 112 cases had evidence of ocular pathology other than cataract. Complete figures are given.—C.C.K.

RETINAL DETACHMENT AND VIBRATION. Milward, D. A. Optical Journal and Review of Optometry, 1940, 77, 14, 28-29.

Milward reports a case in which a patient, while in a barber shop, suffered a detached retina as the result of the application of an electric vibrator on or near the orbital regions. Full symptoms developed within a six day period.—C.C.K.

MIGRAINE AND HEIGHT. Marton, H. B. Optician (London), 1940, 99, 2573, 394.

Marton agrees with the report of Moehlig that 70 per cent of the females and 80 per cent of the males suffering from migraine were found to be six feet or over in height. Marton adds that most of these tall patients with migraine will also be found to be exophoric.—C.C.K.

TWO CASES OF ADIE'S SYNDROME. Kintner, G., Optometric Weekly, 1940, 31, 12, 325-327.

The differences between the tonic pupil (Adie's Syndrome) and the Argyll-Robertson pupil are reviewed and two case reports presented. —C. C. K.

RESTORATION OF VISION AFTER 42 YEAR PERIOD OF BLINDNESS. Blaess, M. J., Eye, Ear, Nose and Throat Monthly, 1940, 19, 9, 279.

Blaess reports a case of congenital cataract in a patient 42 years of age. Despite several prior operations the patient had been blind since birth. Using the Barraquer technique, the opacities were removed and with the aid of cataract lenses useful vision was restored.—C. C. K.

A FEW NOTES ON TEARS. Barnett, A., Optician (London), 1940, 100, 2588, 197.

Barnett reviews the action of the lacrimal gland and discusses tear fluid, this being a watery, colorless chemical solution of which the principal constituent is common salt, but amongst other ingredients of major importance is one discovered by Fleming called lysozyme, which is a most powerful antiseptic. The causes of excess lacrimation are discussed. —C. C. K.

ON PROGRESSIVE LOSS OF VISION OF DENTAL ORIGIN. Rogers, P. W., Columbia Optometrist, 1940, 14, 55, 2.

Rogers presents a case report of a patient, female, age 35, who within a six week period entirely lost the vision of her left eye. The patient's health was normal and an ophthalmoscopic examination

revealed nothing of interest. Several physical examinations were made with negative results. Five non-vital teeth were removed and within a month vision returned to normal.—C. C. K.

OUTLINE FOR PATHOLOGICAL EXAMINATION OF THE EYE. Wolfe, O., Associated Journal of Optometry, 1940, 5, 9, 14-15.

Wolfe presents, in outline form, the diagnostic steps to be taken by optometrists during the course of an ocular examination to determine the presence or absence of ocular pathology. The chart is of interest because it includes the test, symptoms, findings and diagnosis for each step of the routine.—C. C. K.

THE CIRCLE OF ZINN AND MYOPIA. Swann, L. A., Optician (London), 1940, 100, 2585, 147-148.

Swann postulates that a congestion of the blood vessels at the circle or zone of Zinn may cause a slight swelling, which in youth would cause the choroid and sclera to yield slightly, thus causing a myopia. He further surmises that a similar condition occurring in patients of advanced age would cause a glaucoma, because of the rigidity of the sclera at this older age level.—C. C. K.

SECONDARY OCULAR MANIFESTATIONS. Bensman, L. L., Indiana Optometrist, 1940, 12, 11, 6-10.

Bensman points out that optometrists are frequently the first to be consulted by patients who are suffering from ocular pathology and therefore the optometrist should make every effort to screen out these patients. He suggests, as a method of accomplishing this, that a complete case history be taken, a thorough ophthalmoscopic examination be made and in most cases that the visual fields be charted. The author then presents the symptoms and fundus picture in arterio-sclerosis, brain tumors, etc. The material is an abridgment of a lecture presented before the Wisconsin Optometric Association.—C. C. K.

EXTRACTION OF TEETH CLEARS DISEASED EYES. Goodfellow, W. F., Iowa Optometrist, 1940, 17, 2, 6.

A case is reported of incipient cataract in which three abscessed teeth were extracted and opacities of each crystalline lens disappeared.—C. C. K.

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7. OPHTHALMIC LENSES AND MATERIAL.

BIFOCAL ANALYSIS. Nott, W., Canadian Journal of Optometry, 1940, 2, 1, 22-24.

Nott discusses various methods of prescribing bifocal corrections for anisometropic and other highly ametropic patients. The advantages of certain types of bifocal lenses are mentioned by the author as well as bifocals with dissimilar sized segments, bicentric bifocal lenses and bifocals with special prismatic segments.—C. C. K.

FRANKLIN AND HIS BIFOCALS. Barnett, A., The Optician (London), 1940, 100, 2590, 234.

Barnett comments on the origin of bifocal lenses. He credits Franklin with having invented the first bifocal and the French optician, Secretan, with having carried out Franklin's instructions and making the lenses under the direction of the celebrated American. Benjamin Franklin being, according to Barnett, in Paris at the time this event took place.—C. C. K.

DIFFERENTIATION AND SELECTION OF COLORED ABSORPTIVE LENSES. Greenberg, N. H., Bulletin of the Optometrical Society of the City of New York, 1940, 4, 9, 12-14.

The hygienic and therapeutic uses to which various ophthalmic absorption glasses can be put by optometrists are reviewed by Greenberg. Various available lenses are classified by the author according to their absorptive properties—C. C. K.

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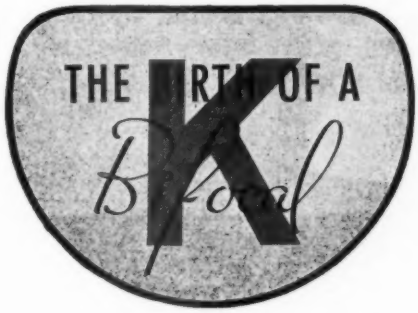

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